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EXAMINER

MACKEY, JAMES P

ART UNIT PAPER NUMBER

1722

17

DATE MAILED: 05/06/2003

Please find below and/or attached an Office communication concerning this application or proceeding.



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1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submissions filed on 20 March 2003 and 04 April 2003 have been entered.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-3, 6-11, 16-20, 23-31, 34-37 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ochiai et al. (U.S. Patent 5,643,831; col. 4, lines 50-60 and col. 6, lines 16-17).

Ochiai et al. '831 teach the mold apparatus 10 substantially as claimed, comprising a substrate 1 of silicon semi-conductor material and having cavities 12 (in the shape of a rhombus, having a width less than a length as clearly shown in Figures 5-7 and 11) formed in the surface of the substrate, a nonstick silicon oxide or silicon nitride protective layer 2 applied to the cavity, and a paste applicator 18 and inherently a paste dispenser for placing paste on the substrate.

Note that the solder paste filled into the cavities 12 of mold 10 completely fills the mold cavities, such that the molded solder bumps are of the same dimensions as the mold cavities, notwithstanding the disclosure of Ochiai et al. that the molded solder bumps are intended to be heated to reflow the solder to subsequently form solder balls 20; a recitation with respect to the

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manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus satisfying the claimed structural limitations, *Ex parte Masham*, 2 USPQ2d 1647. Also note that Ochiai et al. '831 teach that the mold substrate plate is heated (col. 4, line 66), inherently teaching a heating element (claim 24) to accomplish such a heating function.

Ochiai et al. '831 do not explicitly disclose the shape of the cavity being one of trapezoidal, hemispherical, rectangular and square, do not disclose the cavity depth being "about 28 micrometers" (claims 6, 25, 34), do not disclose the protective layer thickness being "from about 200 Angstroms to 5 micrometers" (claims 7, 26, 35), and do not disclose the mold substrate comprising ceramic material (claims 17 and 28).

However, with regard to the shape of the cavity, trapezoidal, hemispherical, rectangular and square shaped cavities are conventional in the molding art for mold cavities for producing solder balls, and therefore it would have been obvious and well within the level of ordinary skill in the art to have provided the wedge-shaped, rhomboid-mouthed cavity of Ochiai et al. '831 in such conventional shapes, since each of the cavity shapes has recognized utility for forming solder balls, and since a skilled artisan would have expected the mold apparatus of Ochiai et al. '831 to perform equally well with the mold cavities having any such conventional cavity shapes.

Also, Ochiai et al. '831 explicitly disclose cavity depths of 70 to 100 micrometers (col. 6, line 62), and further disclose the relationship between cavity depth and the length of the side of the cavity mouth (col. 6, lines 63-67), including graphically correlating the side length to cavity depths of between 0-100 micrometers (as clearly shown in Figure 13), and Ochiai et al. also disclose the utility of forming solder bumps having a thickness of "several tens of  $\mu\text{m}$ " (col. 2,

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lines 38-39); therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ochiai et al. by providing a cavity depth of about 28  $\mu\text{m}$ , since Ochiai et al. recognize the utility of solder bump products of similar thickness, and since Ochiai et al. disclose side lengths of the cavity mouth for a range of cavity depth which clearly overlaps the claimed cavity depth (see Figure 13).

Additionally, Ochiai et al. '831 (Figures 2-3) shows a protective layer thickness approximately corresponding to the upper end of the claimed thickness range. Therefore, it would have been obvious to a skilled artisan to have provided the silicon mold substrate with a silicon oxide or silicon nitride protective layer by oxidizing or nitriding the silicon mold substrate to a protective layer thickness within the claimed range in order to inexpensively produce the protective layer and to minimize altering the cavity shape/depth by the protective layer.

Furthermore, mold substrates formed of ceramic material are conventional in the molding art for mold substrates for producing solder balls, and therefore it would have been obvious and well within the level of ordinary skill in the art to have provided the mold substrate of Ochiai et al. '831 of a ceramic material, since such is a recognized equivalent to silicon for use as a mold substrate for producing solder balls.

4. Claims 12-15, 39 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ochiai et al. '831 as applied to claims 1-3, 6-11, 16-20, 23-31, 34-37 and 41 above, and further in view of Bolstad (U.S. Patent 2,979,773; col. 2, lines 5-14).

Ochiai et al. '831 disclose the mold apparatus substantially as claimed, as described above, including disclosing that the mold substrate plate is heated (col. 4, line 66), except for

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disclosing a heater strip or plural heater strips located on another surface of the mold substrate.

Bolstad discloses heater strips for efficiently providing heat to a semiconductor mold material

22. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ochiai et al. by providing heater strips on the exterior of the mold substrate, as suggested by Bolstad, in order to efficiently provide heat to the mold substrate plate as desired by Ochiai et al. '831.

5. Applicant's arguments filed 20 March 2003 and 04 April 2003 have been fully considered but they are not persuasive.

Applicant argues that Ochiai et al. '831 do not describe that the cavity is substantially the same dimension as the solder ball to be formed; however, Ochiai et al. '831 clearly teach that the solder bumps completely fill the mold cavities, as clearly shown in Figures 1A, 1B and 2, thus meeting the claimed structural limitations in the mold apparatus claims, notwithstanding the disclosure of Ochiai et al. '831 that said molded solder bumps are intended to be heated to reflow the solder to subsequently form solder balls 20.

Applicant argues that Ochiai et al. '831 do not describe the cavity shape as being one of trapezoidal, hemispherical, rectangular and square; however, such cavity shapes are well known and conventional in the molding art for mold cavities for producing solder balls, and it would have been obvious and well within the level of ordinary skill in the art to modify Ochiai et al. '831 by providing the cavities with such conventional shapes in view of the recognized utility of such mold cavity shapes for forming solder balls.

6. All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art

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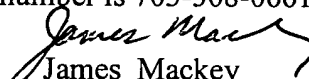
of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to James Mackey whose telephone number is 703-308-1195. The examiner can normally be reached on M-F, 8:30-6:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wanda Walker can be reached on 703-308-0457. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

  
James Mackey  
Primary Examiner  
Art Unit 1722  
5/5/03

jpm  
May 5, 2003